VII Semester Syllabi – Electrical Engineering

B.Tech. EE 2016 Batch Sem-VII [July – Dec 2019]						
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	EE3EXXX	Program Elective – V	3	0	0	3
2	EE3EXXX	Program Elective – VI	3	0	0	3
3	EE3CO20	Modelling and Simulation lab - II	0	0	2	1
4	OEXXXXX	Open Elective-III	3	0	0	3
5	EE3PC01	Project Work I	0	0	8	4
6	EE3PC03	Industrial Training	0	2	0	2
		Total	9	2	10	16
		Total Contact Hours	**21**			

EE3EW01	Advanced Power System Analysis	PS
EE3EL02	Electrical Machine Design	PS/PE/ET
EE3EL07	Power Quality and System Reliability	PS/PE/ET
EE3EW02	EHV AC and DC Transmission	PS
EE3EE02	Wind Energy Systems	ET
EE3EP01	Advanced Power Electronics	PE

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3EW01	Advanced Power System Analysis	3	0	0	3

UNIT I

Introduction- Load modelling concepts, static load models, line loadability, capability curves of alternator, power system network reduction techniques.

UNIT II

Compensation- Load bus voltage control using reactive power control variable, series and shunt compensation, uniform series compensation, uniform shunt compensation, effect on loadability of transmission system.

UNIT III

Sensitivity analysis: Introduction, generalized sensitivity relationships, generation shift distribution factors, line outage distribution factors, compensated shift factors.

UNIT IV

Security analysis: Basic concepts, security functions, levels of power system security, contingency analysis, security control, corrective rescheduling in pre-contingency and post-contingency conditions.

UNIT V

Voltage stability: Introduction, difference between angle stability and voltage stability, proximity and mechanism criteria, voltage stability assessment using PV curve, effect of series and shunt compensation on voltage stability.

Text Books:

1. A. J. Wood and B. F. Wollenberg: Power generation Operation and Control, John Wiley & Sons Inc.
2. I. J. Nagrath and D. P. Kothari: Modern Power System Analysis, Tata McGraw Hill.
3. P. Kundur: Power System Stability and Control, Tata McGraw Hill.

Reference Books :

1. J. J. Grainger and W. D. Stevenson: Power System Analysis, McGraw Hill.
2. Chakrabarti: Power System Analysis Operation and Control, PHI Learning.
3. J. Arrillaga, C. P. Arnord and B. J. Harker: Computer Modelling of Electrical Power Systems, John Wiley & Sons.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3EL02	Electrical Machine Design	3	0	0	3

UNIT I

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise and insulating materials, rating of machines, standard specifications.

UNIT II

Design of Transformers: Output equations of single phase and three phase transformers, choice of specific loadings, expression for volts/turn, determination of main dimensions of the core, estimation of number of turns and conductor cross sectional area of primary and secondary windings, no load current. Expression for the leakage reactance of core type transformer with concentric coils, and calculation of voltage regulation, operating characteristics

UNIT III

Design of Induction Motor: Output equation of induction motor, main dimensions, choice of average flux density, length of air gap- rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines- magnetizing current, short circuit current – operating characteristics- losses and efficiency..

UNIT IV

Design of DC Machines: Output equation, choice of specific loadings and choice of number of poles, main dimensions of armature, design of armature slot dimensions, commutator and brushes. Estimation of ampere turns for the magnetic circuit. Dimensions of yoke, main pole and air gap. Design of shunt and series field windings.

UNIT V

Design of Synchronous Machine: Output equations, choice of electrical and magnetic loading, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Text Books:

1. Performance and Design of A.C. Machines-M.G. Say, Affiliated East West Press Pvt. Ltd., New Delhi.
2. Electrical Machine Design- by A.K. Sawhney, Dhanpat Rai & Sons.
3. Theory & Practice of Electrical machine Design by Dr. N.K. Datta S.K. Kataria & Sons

Reference Books:

1. Design and Testing of Electrical Machines, MV Deshpandey PHI Learning
2. Computer- Aided Design of Electrical Equipment- by Dr. M. Ramamoorthy-Affiliated East-West press Pvt. Ltd. New Delhi
3. Principles of Electrical Machine Design with Computer Programmes by- S.K. Sen, Oxford & IBH Publishing Co.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3EL07	Power Quality and System Reliability	3	0	0	3

UNIT I

Introduction to Power Quality: Meaning of power quality, transients and harmonics, long duration voltage variation, under voltage and over voltage, voltage sag and voltage swell, voltage imbalance, voltage flicker, power frequency variations.

Sources of sags and interruptions, fuse saving and reclosing, induction motor-starting sags, sudden over voltages in system due to load rejection, voltage sag calculation during three phase faults on transmission system, protection against transient over voltages, significance of junction of cable with transmission line, role of current limiting reactors, mitigation of interruption and voltage sag.

UNIT II

Harmonics: Harmonic distortion, voltage versus current disturtion, power system quantities under non-sinusoidal conditions, displacement and true power factor, harmonic Indices, harmonic phase sequence, FC-TCR system for mitigating voltage variation and harmonics elimination using 6-pulse and 12-pulse connection.

UNIT III

Theory of Reliability: Outage, failure rate, repair rate, failure and repair density function, FOR, reliability function, Markov process for calculating availability and unavailability function, series and parallel system.

UNIT IV

Generating System Reliability Evaluation: Generation model, load models, risk model, evaluation of LOLP and indices, effect of maintenance, transmission systems reliability evaluation.

UNIT V

Distribution System Reliability Evaluation: Evaluation of basic reliability indices i.e. system failure rate, average outage time, annual outage time, customer-oriented indices i.e. SAIFI, SAIDI, AENS, CAIDI, evaluation of indices for parallel and radial distribution system. Indices enhancement using fault tolerant and avoidance measures.

Text books

1. Roger c dugan, M. Mcgranaghan, "Electrical Power Systems Quality", TMH.
2. Math H. J. Bollen, "Understanding Power Quality Problems", IEEE press.
3. Roy Billinton and Ronald Allan, "Reliability Evaluation of Power Systems", SIE.
4. A. Ghosh, and G. Ledwich, "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers.

Reference Books

1. J Arrillaga, N R Watson and S Chen, "Power System Quality Assessment", Wiley India.
2. Narain G.Hingorani, Laszio. Gyugyl, "Understanding FACTS Concepts and Technology of Flexible AC Transmission System", Standard Publishers.
3. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Ltd., Publishers New Delhi.
4. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3EW02	EHV AC and DC Transmission	3	0	0	3

UNIT I

Introduction to EHV AC and DC Transmission, Limitations and advantages of AC and DC Transmission, Principal application of AC and DC Transmission, Merits & Demerits of H.V.D.C. over E.H.V. A.C. Transmission. Recent trends in EHV AC and DC Transmission, Constitution of EHV AC and DC Links, Kind of DC Links. Thermal Rating of Lines, Temperature rise of conductors and current carrying capacity of lines and cables, Power handling capacity and line loss.

UNIT II

Voltage profile of loaded and unloaded line, Compensation of lines, series and shunt compensation, Shunt reactors, Tuned power lines, Problems of extra long compensated lines, FACT concept and application. Design of EHV Lines based on Steady-State limits, transients, voltage stability, series and shunt compensation, reactive power and control apparatus.

UNIT III

Travelling waves and their effect on transmission systems, Their shape, attenuation and distortion, effect of junction and termination on propagation of travelling waves, Over voltages in transmission system, Lightning, switching and temporary over voltage: Control of lighting and switching over voltages, surge arresters. Corona Effects and its performance of transmission line.

UNIT IV

Components of EHV dc system, Converter connection, rectifier & inverter waveforms, Complete analysis of 3-phase (6 pulses) bridge converter. Equations of voltage & current on AC& DC side. Reactive power requirements, Fundamentals of Harmonics and Harmonic filters. Commutation failure, Introduction to Multi-terminal D.C. lines.

UNIT V

Control of EHV dc system, desired features of control, control characteristics, constants current control, Constant extinction angle control, Ignition angle control, parallel operation of HVAC & DC system, Problems and advantages.

Text Books:

1. R.D. Begamudre , EHV AC Transmission , Wiley Eastern Ltd.
2. Transmission Line Reference Book: 345 KV and above EPRI, Palo Alto USA.
3. Electrical Transmission and Distribution Reference Book , Oxford book Company, Calcutta.
4. S. Rao, EHV-AC and HV DC Transmission Engineering Practice, Khanna Publishers.

Reference Books:

1. S.Rao, EHV AC & DC Transmission, Khanna Pub.
2. J. Arritilaga, HVDC Transmission, IET.
3. K.R. Padiyar, HVDC Power Transmission System, New Age Pbs.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3EE02	Wind Energy Systems	3	0	0	3

UNIT I

Wind Energy Fundamentals- Wind energy, wind mills, principles of wind energy conversion, site selection considerations, Indian scenario and worldwide developments, present status and future trends. Nature of atmospheric winds, wind resource characteristics and assessment, anemometry, wind statistics, speed frequency distribution, effect of height, wind rose, Weibull distribution, atmospheric turbulence, gust wind speed, effect of topography.

UNIT II

Wind Turbines Types- Vertical axis type, horizontal axis, constant speed constant frequency, variable speed variable frequency, up wind, downwind, stall control, pitch control, gear coupled generator type, direct generator drive /pmg/rotor excited sync generator

UNIT III

Electrical Equipment- General, conventional electrical equipment, power electronic, external-commutated inverters, self-commutated inverters, converters with intermediate circuits, d.c./d.c. choppers, a.c. power controllers, energy storage devices ,electrochemical energy storage, electrical energy storage, mechanical energy storage.

UNIT IV

Wind Energy Systems- Systems feeding into the grid, systems for island supply, wind pumping systems with electrical power transmission, systems for feeding into the grid, general, induction generators for direct grid coupling , asynchronous generators in static cascades, synchronous generators, examples of commercial systems, systems for island operation, systems in combined generation, stand-alone systems.

UNIT V

Wind Energy Systems Design-Wind farm electrical design, planning of wind farms, application, maintenance and operation, wind farm management, environmental assessment; noise, visual impact etc.

Text Books:

1. C S Solanki, "Renewable Energy Technologies", PHI Learning
2. B H Khan, "Non Conventional Energy Resources", PHI Learning.
3. John Twidell & Toney Weir, Renewable Energy Resources, E & F N Spon.

Reference Books:

1. John F. Walker and Jenkins N., "Wind energy technology", John Wiley and sons, N Chichester U.K.
2. Ahmed, "Wind Energy Theory and Practice", PHI, Eastern Economy Edition.
3. L.L. Freris, "Wind Energy Conversion System", Printice Hall.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3EP01	Advanced Power Electronics	3	0	0	3

UNIT I

Switching Voltage Regulators: Review of basic dc-dc voltage regulator configurations -buck, boost, buck-boost converters and their analysis for continuous and discontinuous modes of operation, isolated converters i.e., flyback converter, forward converter, half bridge, full bridge configurations, push-pull converter, cuk converter.

UNIT II

Resonant Pulse Inverters: Introduction, need of resonant converters, Classification of resonant converters, Series Resonant Inverters, Parallel Resonant Inverters, Class E Resonant Inverter, Zero Current Switching (ZCS) Resonant Converters, Zero Voltage Switching Resonant Converters (ZVS), Comparison between ZCS and ZVS Resonant Converters, Two Quadrant ZVS Resonant Converters, Resonant DC – Link Inverters.

UNIT III

Multilevel Inverters: Introduction, need of multi-level inverters, concept of multi-level inverters, topologies for multilevel inverters: diode clamped multilevel inverter, flying capacitors multilevel inverter, cascaded h-bridge multilevel inverter, features and relative comparison of these configurations applications

UNIT IV

AC-AC Converters: Introduction, types of converters, advantages of ac chopper over ac voltage controller, phase controlled ac choppers, half and full wave ac phase controller for R and R-L load, harmonic elimination in PWM ac chopper

UNIT V

Application of FACTS: Definition of Flexible ac Transmission Systems (FACTS), Importance of reactive power compensation, Advantages of FACTS devices, Thyristor- Controlled Reactor (TCR), Fixed Capacitor Thyristor-Controlled Reactor (FC-TCR), Thyristor-Switched capacitor and Reactor, Thyristor-Switched capacitor-Thyristor-Controlled Reactor (TSCTCR), STATCOM configuration and operating principle, Introduction to UPFC and operating principle.

Reference Books:

1. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons.
2. Issa Batarseh, "Power Electronics Circuits", John Wiley & Sons Inc.
3. Undeland, Robbins Mohan, "Power Electronics: Converters Applications and Design, Media Enhanced", Wiley.

Text Books:

1. M H Rashid, "Handbook of Power Electronics", Academic Press Inc.
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India.
3. P.C. Sen, "Modern Power Electronics", S. Chand & Company.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
OE000049	Industrial Instrumentation and Sensor Technology	3	0	0	3

UNIT I

Introduction- Basic industries and functional units, classification of industrial instruments, purpose of instrumentation, performance characteristics-static and dynamic, classification according to properties, classification according to sample state, classification based on basis of signal.

UNIT II

Introduction to Sensor Technology- Applications of different type of sensors, basic sensor network architecture elements, functional configuration of a typical sensor system. Introduction smart sensors.

UNIT III

Level and Flow Measurement -Velocity measurement type flow meters, vortex shedding flow meter, anemometers, mass flow measurement type flow meter, level measurement, optical level indicators.

UNIT IV

Analytical Instrumentation- Chromatography, classification, introductory theory, mass spectrometer, infrared analyzer, ir source and detector, radiation detectors, geiger-muller counter.

UNIT V

Selection, Installation and Calibration of Sensors- Temperature measuring devices, magnetic field sensors, light intensity sensor, sound, humidity, smoke and chemical sensors, radiation measurement, selection, installation and calibration of all sensors.

Text Books:

1. S. K. Singh, Industrial Instrumentation & Control, Tata McGraw-Hill Education.
2. K Krishnaswamy, Industrial Instrumentation, New Age International.

Reference Books:

1. Sabrie Soloman, Sensors Handbook, McGraw-Hill Education.
2. Pavel Ripka and A Tipek, Modern Sensors Handbook, ISTE Ltd.
3. John G. Webster, Measurement Systems & Sensors, CRC Press.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO20	Modelling and Simulation lab - II	0	0	2	1

List of Experiments based on MATLAB/SCILAB

1. Simulation of Transient response of RLC Circuit To an input (i) step (ii) pulse and(iii) Sinusoidal signals
2. Modeling and simulation of D.C. Drives using chopper.
3. Modeling and simulation of D.C. Drives using converters.
4. Modeling and simulation of single phase inverter with PWM control techniques.
5. Modeling and simulation of three phase inverter with SPWM control techniques.
6. Modeling and simulation of three phase A.C. IM using inverter circuit.
7. Modeling and simulation of three phase inverter with PWM control techniques.
8. Design pulse generator for controlled converters.
9. To find the fault current in a given power system where there is
   a) Balanced 3-f fault. (LLL/LLLG) b) Single line to ground fault(LG).
   c) Line to line fault (LL) d) Double line to ground fault(LLG).
10. Mathematical modeling of photovoltaic cell.
11. To design MPPT for solar PV system.
12. Introduction to fuzzy logic: definition, FIS, MF, applications.

Text Books:

1. Rudra Pratap, Getting Started with MATLAB - A Quick introduction for Scientists & Engineers, Oxford Univ. Press.
2. S. Jain, Modelling and Simulation Using Matlab-Simulink, Willey India.

Reference Books:

1. Tejas B. Sheth, Scilab: A Practical Introduction to Programming and Problem Solving, Create Space Independent Publishing Platform.
2. M. Ganesh - Introduction to fuzzy sets and fuzzy logic, PHI.
3. Averill Law, Simulation Modeling and Analysis, McGraw Hill Education

VII Semester Syllabi – Electrical & Electronics Engineering

B.Tech. EX 2016 Batch Sem-VII [July-Dec2019]						
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	EX3EXXX	Program Elective-V	3	0	0	3
2	EX3EXXX	Program Elective-VI	3	0	0	3
3	EX3CO20	Modelling and Simulation lab - II	0	0	2	1
4	OEXXXXX	Open Elective-III	3	0	0	3
5	EX3PC01	Project Work I	0	0	8	4
6	EX3PC03	Industrial Training	0	2	0	2
		Total	9	2	10	16
		Total Contact Hours	21			

EX3EW01	Advanced Power System Analysis	PS
EX3EL02	Electrical Machine Design	PS/PE/ET
EX3EL07	Power Quality and System Reliability	PS/PE/ET
EX3EW02	EHV AC and DC Transmission	PS
EX3EE02	Wind Energy Systems	ET
EX3EP01	Advanced Power Electronics	PE

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EX3EW01	Advanced Power System Analysis	3	0	0	3

UNIT I

Introduction- Load modelling concepts, static load models, line load ability, capability curves of alternator, power system network reduction techniques.

UNIT II

Compensation- Load bus voltage control using reactive power control variable, series and shunt compensation, uniform series compensation, uniform shunt compensation, effect on load ability of transmission system.

UNIT III

Sensitivity Analysis: Introduction, generalized sensitivity relationships, generation shift distribution factors, line outage distribution factors, compensated shift factors.

UNIT IV

Security Analysis: Basic concepts, security functions, levels of power system security, contingency analysis, security control, corrective rescheduling in pre-contingency and post-contingency conditions.

UNIT V

Voltage Stability: Introduction, difference between angle stability and voltage stability, proximity and mechanism criteria, voltage stability assessment using PV curve, effect of series and shunt compensation on voltage stability.

Text Books

1. A. J. Wood and B. F. Wollenberg: Power generation Operation and Control, John Wiley & Sons Inc.
2. I. J. Nagrath and D. P. Kothari: Modern Power System Analysis, Tata McGraw Hill.
3. P. Kundur: Power System Stability and Control, Tata McGraw Hill.

Reference Books

1. J. J. Grainger and W. D. Stevenson: Power System Analysis, McGraw Hill.
2. A. Chakrabarti: Power System Analysis Operation and Control, PHI Learning.
3. A. J. Arrillaga, C. P. Arnord and B. J. Harker: Computer Modelling of Electrical Power Systems, John Wiley & Sons.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EX3EL02	Electrical Machine Design	3	0	0	3

UNIT I

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise and insulating materials, rating of machines, standard specifications.

UNIT II

Design of Transformers: Output equations of single phase and three phase transformers, choice of specific loadings, expression for volts/turn, determination of main dimensions of the core, estimation of number of turns and conductor cross sectional area of primary and secondary windings, no load current. Expression for the leakage reactance of core type transformer with concentric coils, and calculation of voltage regulation, operating characteristics

UNIT III

Design of Induction Motor: Output equation of induction motor, main dimensions, choice of average flux density, length of air gap- rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines- magnetizing current, short circuit current – operating characteristics- losses and efficiency..

UNIT IV

Design of DC Machines: Output equation, choice of specific loadings and choice of number of poles, main dimensions of armature, design of armature slot dimensions, commutator and brushes. Estimation of ampere turns for the magnetic circuit. Dimensions of yoke, main pole and air gap. Design of shunt and series field windings.

UNIT V

Design of Synchronous Machine: Output equations, choice of electrical and magnetic loading, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Text Books:

1. Performance and Design of A.C. Machines-M.G. Say, Affiliated East West Press Pvt. Ltd., New Delhi.
2. Electrical Machine Design- by A.K. Sawhney, Dhanpat Rai & Sons.
3. Theory & Practice of Electrical machine Design by Dr. N.K. Datta S.K. Kataria & Sons

Reference Books:

1, Design and Testing of Electrical Machines, MV Deshpandey PHI Learning
2. Computer- Aided Design of Electrical Equipment- by Dr. M. Ramamoorthy-Affiliated East-West press Pvt. Ltd. New Delhi
3. Principles of Electrical Machine Design with Computer Programmes by- S.K. Sen, Oxford & IBH Publishing Co.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EX3EL07	Power Quality and System Reliability	3	0	0	3

UNIT I

Introduction to Power Quality: Meaning of power quality, transients and harmonics, long duration voltage variation, under voltage and over voltage, voltage sag and voltage swell, voltage imbalance, voltage flicker, power frequency variations.

Sources of sags and interruptions, fuse saving and reclosing, induction motor-starting sags, sudden over voltages in system due to load rejection, voltage sag calculation during three phase faults on transmission system, protection against transient over voltages, significance of junction of cable with transmission line, role of current limiting reactors, mitigation of interruption and voltage sag.

UNIT II

Harmonics: Harmonic distortion, voltage versus current distortion, power system quantities under non-sinusoidal conditions, displacement and true power factor, harmonic Indices, harmonic phase sequence, FC-TCR system for mitigating voltage variation and harmonics elimination using 6-pulse and 12-pulse connection.

UNIT III

Theory of Reliability: Outage, failure rate, repair rate, failure and repair density function, FOR, reliability function, Markov process for calculating availability and unavailability function, series and parallel system.

UNIT IV

Generating System Reliability Evaluation: Generation model, load models, risk model, evaluation of LOLP and indices, effect of maintenance, transmission systems reliability evaluation.

UNIT V

Distribution System Reliability Evaluation: Evaluation of basic reliability indices i.e. system failure rate, average outage time, annual outage time, customer oriented indices i.e. SAIFI, SAIDI, AENS, CAIDI, evaluation of indices for parallel and radial distribution system. Indices enhancement using fault tolerant and avoidance measures.

Text books:

1. Roger C Dugan, M. Mcgranaghan, "Electrical Power Systems Quality", TMH.
2. Math H. J. Bollen, "Understanding Power Quality Problems", IEEE press.
3. Roy Billinton and Ronald Allan, "Reliability Evaluation of Power Systems", SIE.
4. Ghosh, and G. Ledwich, "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers.

Reference Books:

1. J Arrillaga, N.R Watson and S Chen, "Power System Quality Assessment", Wiley India.
2. Narain G.Hingorani, Laszio. Gyugyl, "Understanding FACTS Concepts and Technology of Flexible AC Transmission System", Standard Publishers.
3. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Ltd., Publishers New Delhi.
4. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EX3EW02	EHV AC and DC Transmission	3	0	0	3

UNIT I

Introduction to EHV AC and DC Transmission, Limitations and advantages of AC and DC Transmission, Principal application of AC and DC Transmission, Merits & Demerits of H.V.D.C. over E.H.V. A.C. Transmission. Recent trends in EHV AC and DC Transmission, Constitution of EHV AC and DC Links, Kind of DC Links. Thermal Rating of Lines, Temperature rise of conductors and current carrying capacity of lines and cables, Power handling capacity and line loss.

UNIT II

Voltage profile of loaded and unloaded line, Compensation of lines, series and shunt compensation, Shunt reactors, Tuned power lines, Problems of extra long compensated lines, FACT concept and application. Design of EHV Lines based on Steady-State limits, transients, voltage stability, series and shunt compensation, reactive power and control apparatus.

UNIT III

Travelling waves and their effect on transmission systems, Their shape, attenuation and distortion, effect of junction and termination on propagation of travelling waves, Over voltages in transmission system, Lightning, switching and temporary over voltage: Control of lighting and switching over voltages, surge arresters. Corona Effects and its performance of transmission line.

UNIT IV

Components of EHV dc system, Converter connection, rectifier & inverter waveforms, Complete analysis of 3-phase (6 pulses) bridge converter. Equations of voltage & current on AC& DC side. Reactive power requirements, Fundamentals of Harmonics and Harmonic filters. Commutation failure, Introduction to Multi-terminal D.C. lines.

UNIT V

Control of EHV dc system, desired features of control, control characteristics, constants current control, Constant extinction angle control, Ignition angle control, parallel operation of HVAC & DC system, Problems and advantages.

Text Books:

1. R.D. Begamudre , EHV AC Transmission , Wiley Eastern Ltd., 2nd edition .
2. Transmission Line Reference Book: 345 KV and above EPRI, Palo Alto USA.
3. Electrical Transmission and Distribution Reference Book , Oxford book Company, Calcutta.
4. S. Rao ,EHV –AC and HV DC Transmission Engineering Practice, Khanna Publishers.

Reference Books:

1. S.Rao, EHV AC & DC Transmission.
2. Arritilaga, HVDC Transmission.
3. Padiyar, HVDC Transmission, New Age Pbs.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EX3EE02	Wind Energy Systems	3	0	0	3

UNIT I

Wind Energy Fundamentals- Wind energy, wind mills, principles of wind energy conversion, site selection considerations, Indian scenario and worldwide developments, present status and future trends. Nature of atmospheric winds, wind resource characteristics and assessment, anemometry, wind statistics, speed frequency distribution, effect of height, wind rose, Weibull distribution, atmospheric turbulence, gust wind speed, effect of topography.

UNIT II

Wind Turbines Types- Vertical axis type, horizontal axis, constant speed constant frequency, variable speed variable frequency, up wind, down wind, stall control , pitch control, gear coupled generator type, direct generator drive /pmg/rotor excited sync generator

UNIT III

Electrical Equipment- General, conventional electrical equipment, power electronic, external-commutated inverters, self-commutated inverters, converters with intermediate circuits, d.c./d.c. choppers, a.c. power controllers, energy storage devices ,electrochemical energy storage, electrical energy storage, mechanical energy storage.

UNIT IV

Wind Energy Systems- Systems feeding into the grid, systems for island supply, wind pumping systems with electrical power transmission, systems for feeding into the grid, general, induction generators for direct grid coupling , asynchronous generators in static cascades, synchronous generators, examples of commercial systems, systems for island operation, systems in combined generation, stand-alone systems.

UNIT V

Wind Energy Systems Design-Wind farm electrical design, planning of wind farms, application, maintenance and operation, wind farm management, environmental assessment; noise, visual impact etc.

Text Books:

1. C S Solanki, "Renewable Energy Technologies", PHI Learning
2. B H Khan, "Non Conventional Energy Resources", PHI Learning.
3. John Twidell & Toney Weir, Renewable Energy Resources, E & F N Spon.

Reference Books:

1. John F. Walker and Jenkins N., "Wind energy technology", John Wiley and sons, N Chichester U.K.
2. Ahmed, "Wind Energy Theory and Practice", PHI, Eastern Economy Edition.
3. L.L. Freris, "Wind Energy Conversion System", Printice Hall.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EX3EP01	Advanced Power Electronics	3	0	0	3

UNIT I

Switching Voltage Regulators: Review of basic dc-dc voltage regulator configurations -buck, boost, buck-boost converters and their analysis for continuous and discontinuous modes of operation, isolated converters i.e., flyback converter, forward converter, half bridge, full bridge configurations, push-pull converter, cuk converter.

UNIT II

Resonant Pulse Inverters: Introduction, need of resonant converters, Classification of resonant converters, Series Resonant Inverters, Parallel Resonant Inverters, Class E Resonant Inverter, Zero Current Switching (ZCS) Resonant Converters, Zero Voltage Switching Resonant Converters (ZVS), Comparison between ZCS and ZVS Resonant Converters, Two Quadrant ZVS Resonant Converters, Resonant DC – Link Inverters.

UNIT III

Multilevel Inverters: Introduction, need of multi-level inverters, concept of multi-level inverters, topologies for multilevel inverters: diode clamped multilevel inverter, flying capacitors multilevel inverter, cascaded h-bridge multilevel inverter, features and relative comparison of these configurations applications

UNIT IV

AC-AC Converters: Introduction, types of converters, advantages of ac chopper over ac voltage controller, phase controlled ac choppers, half and full wave ac phase controller for R and R-L load, harmonic elimination in PWM ac chopper

UNIT V

Application of FACTS: Definition of Flexible ac Transmission Systems (FACTS), Importance of reactive power compensation, Advantages of FACTS devices. Thyristor- Controlled Reactor (TCR), Fixed Capacitor Thyristor-Controlled Reactor (FC-TCR), Thyristor-Switched capacitor and Reactor, Thyristor-Switched capacitor-Thyristor-Controlled Reactor (TSCTCR), STATCOM configuration and operating principle, Introduction to UPFC and operating principle.

Text Books:

1. M H Rashid, "Handbook of Power Electronics", Academic Press Inc.
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India.
3. P.C. Sen, "Modern Power Electronics ", S. Chand & Company.

Reference Books:

1. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons.
2. Issa Batarseh, "Power Electronics Circuits", John Wiley & Sons Inc.
3. Undeland, Robbins Mohan, "Power Electronics: Converters Applications and Design, Media Enhanced", Wiley.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
OE00049	Industrial Instrumentation and Sensor Technology	3	0	0	3

UNIT I

Introduction- Basic industries and functional units, classification of industrial instruments, purpose of instrumentation, performance characteristics-static and dynamic, classification according to properties, classification according to sample state, classification based on basis of signal.

UNIT II

Introduction to Sensor Technology- Applications of different type of sensors, basic sensor network architecture elements, functional configuration of a typical sensor system. Introduction smart sensors.

UNIT III

Level and Flow Measurement -Velocity measurement type flow meters, vortex shedding flow meter, anemometers, mass flow measurement type flow meter, level measurement, optical level indicators.

UNIT IV

Analytical Instrumentation- Chromatography, classification, introductory theory, mass spectrometer, Infrared analyzer, ir source and detector, radiation detectors, geiger-muller counter.

UNIT V

Selection, Installation and Calibration of Sensors- Temperature measuring devices, magnetic field sensors, light intensity sensor, sound, humidity, smoke and chemical sensors, radiation measurement, selection, installation and calibration of all sensors.

Text Books

1. S. K. Singh, Industrial Instrumentation & Control, Tata McGraw-Hill Education.
2. K Krishnaswamy, Industrial Instrumentation, New Age International.

Reference Books:

1. Sabrie Soloman, Sensors Handbook, McGraw-Hill Education.
2. Pavel Ripka and A Tipek, Modern Sensors Handbook, ISTE Ltd.
3. John G. Webster, Measurement Systems & Sensors, CRC Press.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EX3CO20	Modelling and Simulation lab - II	0	0	2	1

List of Experiments based on MATLAB/SCILAB

1. Simulation of Transient response of RLC Circuit To an input (i) step (ii) pulse and(iii) sinusoidal signals
2. Modeling and simulation of D.C. Drives using chopper.
3. Modeling and simulation of D.C. Drives using converters.
4. Modeling and simulation of single phase inverter with PWM control techniques.
5. Modeling and simulation of three phase inverter with SPWM control techniques.
6. Modeling and simulation of three phase A.C. IM using inverter circuit.
7. Modeling and simulation of three phase inverter with PWM control techniques.
8. Design pulse generator for controlled converters.
9. To find the fault current in a given power system where there is
   a) Balanced 3-f fault. (LLL/LLLG) b) Single line to ground fault(LG).
   c) Line to line fault(LL) d) Double line to ground fault(LLG).
10. Mathematical modeling of photovoltaic cell.
11. To design MPPT for solar PV system.
12. Introduction to fuzzy logic: definition, FIS, MF, applications.

Text Books:

1. Rudra Pratap, Getting Started with MATLAB - A Quick introduction for Scientists & Engineers, Oxford Univ. Press.
2. S. Jain, Modelling and Simulation Using Matlab-Simulink, Willey India.

Reference Books:

1. Tejas B. Sheth, Scilab: A Practical Introduction to Programming and Problem Solving, Create Space Independent Publishing Platform.
2. M. Ganesh - Introduction to fuzzy sets and fuzzy logic, PHI.
3. Averill Law, Simulation Modeling and Analysis, McGraw Hill Education